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# COMBINING 2D AND 3D VIRTUAL ELEMENTS FOR SOLVING FLOW IN FRACTURED POROUS MEDIA

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**Abstract.** Subsurface flow is an important phenomena in the study of reservoirs, water resources, geothermal applications, oil and gas extraction and storage, etc. One approach for solving the problem is to homogenize the media into a continuum. In this way meshing is mostly trivial but introduces simplifications in the original problem. Another approach is to consider the network defined by the fractures of the media, a Discrete Fracture Network (DFN), which is a complex 3D set made up by intersecting planar fractures. The complexity of the network generates unavoidable meshing challenges that may render impossible the meshing process. The Virtual Element Method (VEM) is a recently introduced numerical method that can be seen as a generalization of the standard Finite Element to polygonal meshes. The 2D VEM has already been successfully applied to solving flow in Discrete Fracture Networks while the framework for the three dimensional version has been recently developed. In this work we put forward a new approach for simulating flow in a porous fractured media, by using 3D elements for the porous matrix and 2D elements for the DFN. We introduce a coupling between the two types of elements so as to allow for flux exchange between the matrix and the network. Using Virtual Elements to obtain global conformity of the mesh, we preserve the complexity of the underlying DFN without introducing simplifications while avoiding all the problems that arise during the meshing process.